



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
OREGON OPERATIONS OFFICE
805 SW Broadway, Suite 500
Portland, Oregon 97205

December 18, 2009

Mr. Robert Wyatt
Northwest Natural & Chairman, Lower Willamette Group
220 Northwest Second Avenue
Portland, Oregon 97209

Re: Portland Harbor Superfund Site; Administrative Order on Consent for Remedial Investigation and Feasibility Study; Docket No. CERCLA-10-2001-0240 – Remedial Action Alternatives Development and Screening Evaluation

Dear Mr. Wyatt:

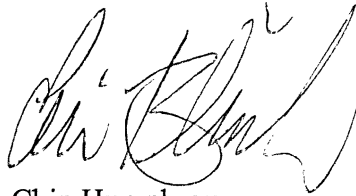
The attached comments represent EPA's response to the Lower Willamette Group's November 17, 2009 presentation on the development and screening of remedial action alternatives as part of the feasibility study (FS) for the Portland Harbor Superfund Site. EPA has developed these comments to allow the LWG to initiate the Portland Harbor FS such that a draft FS can be submitted to EPA in the fall of 2010. EPA has provided comments on the overall approach, specific tools used in the evaluation and general direction on the application of water quality standards, the identification of principle threat material and hot spots of contamination, and the scope of long-term monitoring efforts.

Overall, EPA is supportive of the approach outlined by the LWG during the November 17, 2009. However, it is imperative that the screening level evaluation clearly document the basis for eliminating remedial action technologies, process options and/or alternatives from further consideration in the detailed evaluation of remedial action alternatives. EPA appreciates the need to present screening information efficiently, however, the analysis must be sufficiently detailed to support the elimination of alternatives.

EPA will be providing preliminary comments on the baseline human health and ecological risk assessments and a set of ARARs for use in the Portland Harbor FS under separate cover in the near future. EPA expects that the attached and aforementioned comments will be incorporated into the remedial action alternative development and screening step and that the LWG will be prepared to present the results of the evaluation process during a check-in meeting to take place in April 2010.

If you have any questions regarding this matter, please contact Chip Humphrey at (503) 326-2678 or Eric Blischke (503) 326-4006. All legal inquiries should be directed to Lori Cora at (206) 553-1115.

Sincerely,

A handwritten signature in black ink, appearing to read 'Chip Humphrey', with a large, stylized flourish at the end.

Chip Humphrey
Eric Blischke
Remedial Project Managers

cc: Greg Ulirsch, ATSDR
Rob Neely, NOAA
Ted Buerger, US Fish and Wildlife Service
Preston Sleeper, Department of Interior
Jim Anderson, DEQ
Kurt Burkholder, Oregon DOJ
David Farrer, Oregon Environmental Health Assessment Program
Rick Keppler, Oregon Department of Fish and Wildlife
Michael Karnosh, Confederated Tribes of Grand Ronde
Tom Downey, Confederated Tribes of Siletz
Audie Huber, Confederated Tribes of Umatilla
Brian Cunningham, Confederated Tribes of Warm Springs
Erin Madden, Nez Perce Tribe
Rose Longoria, Confederated Tribes of Yakama Nation

EPA COMMENTS ON THE REMEDIAL ACTION ALTERNATIVES DEVELOPMENT AND
SCREENING EVALUATION FOR THE PORTLAND HARBOR SITE
DECEMBER 18, 2009

EPA is providing these comments in response to our November 17, 2009 meeting to discuss the remedial action alternatives development and screening evaluation for the Portland Harbor Site. Overall, EPA is supportive of the process outlined at the meeting. Although EPA recognizes that many of the details supporting the screening evaluation could not be presented during the November 17, 2009 meeting, it is imperative that the alternative screening evaluation clearly document the basis for eliminating remedial action technologies, process options and/or alternatives from further consideration in the detailed evaluation of remedial action alternatives. The screening process should rely on the application of a consistent set of principles applied in a balanced manner. EPA appreciates the need to present screening information efficiently; however, the analysis must be sufficiently detailed to support the elimination of alternatives – especially those alternatives that will be of interest to the public and other Portland Harbor stakeholders.

FS Process Overview:

The following comments present a series of general comments regarding the overall process presented in slides 3 – 20 from the November 17, 2009 presentation material. EPA has inserted additional steps in the process for clarity. A summary of the overall process is presented in Table 1. Additional, more detailed comments are provided in the specific comments below.

Development of RAOs, PRGs and AOPCs on a Site-Wide Basis:

These steps have generally been completed. However, EPA is in the process of finalizing our expedited comments on the baseline human health and ecological risk assessments. EPA expects that our comments, on the baseline ecological risk assessment in particular, will result in modification to the PRGs that were used to develop AOPCs. It is unclear whether these changes will markedly change the AOPCs developed jointly by EPA and the LWG as documented in our letter dated June 23, 2009. However, it is important that all COCs identified as posing unacceptable risk be used to develop PRG so that the necessary contaminant information is available to screen remedial action alternatives.

Identification of GRAs on a Site-Wide Basis:

Identification of general response actions (GRAs) was not included in the overall process as depicted on Slides 3 and 4. Consistent with EPA's 1988 RI/FS guidance, GRAs must be developed, prior to the technology screening step. The Portland Harbor FS work plan presented the following GRAs: No action, institutional controls, monitored natural recovery, containment (capping), in-situ treatment, removal and disposal, and removal and treatment. Although the work plan stated that these GRAs would be further refined, it is unclear the extent to which GRA refinement is necessary. Refinements may include the inclusion of thin layer placement or enhanced MNR and the use of active capping technologies.

Site Wide Technology Identification and Technology and Process Option Screening

Technology identification and screening should be performed on a site-wide basis as depicted in Slide 7. As a result, the technology screening step should take place earlier in the process than is shown on Slide 4. The screening of technologies should be based on technical implementability. In-situ and ex-situ treatment technologies should be included as necessary to treat principle threat material. Retained technologies and process options should be further screened based on effectiveness, implementability and cost consistent with EPA's 1988 Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (CERCLA RI/FS Guidance). An example technology and process option screening table is presented as Table 2.

This step is generally considered complete. The LWG provided a set of treatment screening tables to EPA on June 5, 2009. EPA commented on the treatment screening tables on July 9, 2009. However it is unclear whether all EPA comments were incorporated into the list of technologies carried forward presented on Slides 14 and 15. For example, it is unclear whether composting was screened out and on what basis. The same comment applies to treatment technologies such as incineration, pyrolysis and thermal desorption; in-situ chemical and biological treatment; and chemical extraction. Some comments, such as our comments regarding the use of Geotextile tubes appear to have been incorporated into the screening process. It is important that the technology screening step clearly demonstrate that previously provided EPA comments were incorporated into the evaluation.

AOPC to SMA Conversion:

EPA agrees that subsurface sediment data should be evaluated to determine whether adjustment to the current AOPCs is required. In addition to the evaluation of subsurface sediment contamination, this evaluation should consider whether subsurface contamination can migrate to the surface based on groundwater upwelling as well as physical processes such as erosion due to river flow or prop-wash. Additionally, subsurface contamination must be considered in what institutional controls may or may not be effective and reliable in the long-term for assuring subsurface contamination is either not disturbed, or handled appropriately if future use or development occurs.

The AOPC to SMA conversion step is a major element of the screening process that directly affects where active remediation will be considered. SMAs should be identified through and evaluation of chemical, physical and site characteristics. Although the distribution of contaminant concentrations should be considered in SMA development, it is imperative that a range of remedial action technologies be considered for each SMA as long as that technology is considered effective. For example, even in low concentration areas, active remediation to a range of RALs that exceed protective or background concentrations should be considered.

SMA Alternatives Development and Screening:

According to the CERCLA RI/FS guidance, technology process options are to be screened against effectiveness, implementability and cost. In order to streamline the screening of remedial action alternatives, process options that have been retained based on technical implementability

should be combined into a range of remedial action alternatives and screened based on effectiveness, implementability and cost on an SMA basis. Remedial action alternatives should not be eliminated based on cost alone. As stated in Section 4.2.5.3 of EPA's CERCLA RI/FS guidance, cost plays a limited role in the screening of process options. Higher cost options should only be eliminated if there is a substantially lower cost alternative that is equal in terms of effectiveness and implementability while meeting regulatory requirements and NCP remedy expectations. Table 3 presents an approach for the screening of remedial action alternatives on an SMA basis.

Example Screening Matrix:

EPA agrees that this is a useful way of presenting the outcome of the screening step. However, the following changes to the matrix must be incorporated:

- In-Situ Treatment should be added as a process option for evaluation.
- All SMAs (including SMAs that are identified as MNR only) must consider the following time frames: Time zero (i.e., the alternative screening step must consider other combinations of technologies that will achieve the RAOs immediately following construction), Time = 10 years and time = 30 years.
- EPA does not agree with the designation "Not considered necessary to evaluate." All alternatives that are effective should be evaluated. Equally effective alternatives may be eliminated based on cost and implementability.
- As stated previously, remedial action alternatives should be screened based on a combination of effectiveness, implementability and cost. The basis for eliminating a given alternative must be clearly documented and justified.
- For "Hot Spots" of contamination a higher cost threshold for removal and disposal and removal and treatment should be applied. For principle threat material, the screening evaluation should reflect a preference for treatment consistent with the NCP and EPA's sediment guidance.

Example Alternative Development Matrix:

It is important that an appropriate range of remedial action alternatives be evaluated for all SMAs. It is inappropriate to only present a single remedial action alternative for a given SMA (e.g., MNR for SMA 13a). All SMAs should include evaluation of a range of timeframes to achieve RAOs and a range of PRGs. Considering a range of timeframes, including immediately following construction, will necessitate inclusion of other technology process options such as enhanced MNR to address lower concentration areas and dredging and/or capping to address higher concentration areas. This analysis would also provide a basis for identification of contingencies where MNR is selected but future monitoring shows that it is not effective.

Tools and Methods:

PRGs: EPA comments on the baseline human health and ecological risk assessments should be incorporated in to the PRG development process. Overall, the suite of PRGs selected is too limited. It will be important to carry forward a range of PRGs that reflect all relevant exposure

pathways (e.g., human health fish consumption, benthic risk), chemical class (e.g., metals, VOCs, SVOCs, bioaccumulative chemicals), physical-chemical properties (e.g., mobility, degradation potential) and toxicity. In addition, a range of PRGs should be identified for each chemical and exposure pathway. This will ensure an appropriate range of remedial technologies is considered. The presence of additional chemicals may affect the decisions on effectiveness, implementability and cost of certain alternatives. For example, we may determine that capping is ineffective in areas of highly mobile constituents such as arsenic or VOCs.

Monitored Natural Recovery: The evaluation should consider a range of time frames. At a minimum MNR should be evaluated on a 10 year and 30 year time frame. In addition, the remedial alternative screening step should consider the ability to achieve the RAOs immediately following construction (i.e., time zero). This will require further evaluation of remedial action alternatives in areas such as the example SMA 13a.

In addition to the HST Modeling results, areas of erosion and scour should be identified based on empirical information including sediment trap results, bathymetric surveys, and grain size measurements, SedFlume results, and other site information.

It is unclear how much of the MNR approach presented will be utilized in the actual evaluation. EPA understands that the use of the hydrodynamic sedimentation transport (HST) and contaminant fate and transport (F&T) models will be used to identify areas where MNR may be effective. However, just to be on record, EPA does not believe that the approaches presented for PCBs and PAHs (Slides 38 and 39) are valid. In addition, any assumptions about chemical and/or biological degradation must be supported with site specific information.

Background: EPA does not agree with the background evaluation approaches presented on Slide 34. EPA has previously directed the LWG on the development of background concentrations and expects this approach to be used in the FS. In addition, the use of background concentrations as replacement values in the hilltopping analysis is inappropriate. Ideally, the fate and transport model can be used to estimate the surface sediment contaminant concentration following recontamination by upstream material. It is likely that some contaminated material above background will remain in place at the site following construction. The degree of active remediation performed at the site will have a direct effect on the post remedy contaminant concentrations. EPA would agree that contaminant concentrations below background or 10 – 6 risk levels will not require active remediation.

Volume Determination: It is unclear whether the 3X PRG multiplier is an appropriate approach for developing volume estimates. EPA appreciates the difficulty in this evaluation due to the distribution of subsurface sediment data and the range of depths over which chemical analysis was performed. It is likely that the pattern of contamination for subsurface contamination at a given depth is very different from the pattern of surface sediment contamination. EPA does support the use of sediment core results and cross sections to develop volume estimates as presented in slide 42.

Cap Effectiveness: EPA supports the use of simple cap models to evaluate the effectiveness of capping technologies. EPA believes that the contaminant concentrations should be estimated at

the bottom of the biologically active zone (i.e., 10 cm depth). In areas of contaminated groundwater discharges, some reduction in flux consistent with the expected source control measure is appropriate.

EPA supports the development of generic cap designs for use in the FS. In addition to the generic designs presented on Slide 46, a habitat friendly cap design should be included for use in low energy areas where erosion is not expected. This may reduce the mitigation costs associated with capping technologies. Appropriate models (e.g., HST, prop wash, and wave analysis should be used to determine the appropriate level of armoring required at specific location across the site.

The appropriate flood rise model must be run to support the FS evaluation (FEMA HAZUS-MH Flood Model).

Use of Bioaccumulation Criteria: EPA does not agree that the use of ambient water quality criteria is inconsistent with the risk assessment results. The analysis presented on Slide 51 compares sediment concentrations in the 2 – 5 ug/kg range with a hill-topped concentration of 70 ug/kg. This is an inappropriate comparison. Sediment concentrations in the 2-5 ug/kg range estimated through application of a partitioning analysis and the fish consumption AWQC of 64 pg/l compare favorably to sediment PRGs based on 17.5 g/day and a 10⁻⁶ risk level which is the basis for development of the fish consumption AWQC. For example, the 10⁻⁶ risk level PRG for a large home range fish is 0.7 to 1.4 ug/kg.

Dredge Depths: Some consideration of the effective depth of dredging that considers the range of dredging technologies available and maintenance of slope stability should be included in the remedial action alternative development and screening step.

Cost Assumptions: Costs need to include long-term operation and maintenance and long-term monitoring. Sites that are expected to have perpetual operation and maintenance costs may require a time-frame longer than 30 years. In addition, an appropriate discount rate should also be applied for the purposes of developing accurate cost estimates. Attachment 4 provides considerations regarding long-term monitoring costs. Cost methods presented in “A Guide to Developing and Documenting Cost Estimates during the Feasibility Study” (USEPA and USACE, 2000) should be utilized. EPA encourages the LWG to work with the National Marine Fisheries Service (NMFS) to develop an appropriate mitigation framework that can be used to help estimate potential mitigation costs. In addition, the most up to date disposal costs for upland disposal should be obtained by contacting disposal facilities directly.

Implementability Screening Step: Remedial action alternatives should be evaluated against effectiveness, implementability and cost together. It is inappropriate to screen against implementability first. Cost may be used to screen alternatives consistent with EPA guidance as long as it can be demonstrated that other alternatives are at least as effective and implementable as the higher cost option. Considering SMA 13d for example, full removal may be screened out based on cost if it can be demonstrated that dredge and cap is equally or more effective and implementable as full removal and if the information is presented in a transparent manner such that EPA and the general public and fully understand the basis for screening out a given remedial

action alternative such as full removal. Likewise, the costs for long-term monitoring and ICs for MNR may close the cost gap with other alternatives.

There is a distinction between remedies that are not implementable due to considerations such as the placement of cap material in areas of navigation that results in an unacceptable channel depth and remedies that are implementable but costly such as the removal and replacement of structures that may hinder access to contaminated material. This concept should be reflected appropriately in the evaluation of effectiveness, implementability and cost. For example, when evaluating the feasibility of in-water structure removal to remediate contaminated sediments, if other options such as diver assisted hydraulic dredging or capping is equally effective, it may be possible to screen out structure removal based on cost.

Table 1
Recommended Remedial Action Alternative Development, Screening and Detailed Evaluation Process

Step No.	Action	Description
1	Develop RAOs, PRGs, AOPCs	This step is generally considered complete pending EPA comments on the BERA and BHHRA. All remedial action alternatives developed on an SMA basis must consider a range of options that meet the RAO for all contaminants that are presenting a risk. A range of time-frames for achieving the RAO may be considered.
2	Identify and Refine GRAs on a Site-Wide Basis	GRAs are general categories of action, typically including No Action, Institutional Controls, Containment, In-Situ Treatment, Removal and Ex-Situ Treatment, and Removal and Disposal. GRAs were identified in the Portland Harbor Programmatic Work Plan (Appendix A). GRAs should be refined as necessary to ensure that an appropriate suite of remedial action technologies are evaluated in the FS.
3	Identify and Screen Remedial Technologies and Process Options	Remedial action technologies applicable to each GRA should be identified, refined into process options, and screened based on effectiveness and technical implementability. At this level of screening the key issue is whether a technology is effective at addressing contaminated sediment based on a consideration of site specific factors and the degree to which the technology has been applied to contaminated sediments at the bench scale, pilot scale or full scale level.
4	Convert AOPCs to SMAs	Sediment management areas (SMAs) should be developed based on an evaluation of site characteristics relevant to the screening, development and detailed evaluation of remedial action alternatives. Site characteristics that should be considered include contaminant sources and distribution, contaminant migration and exposure pathways, mutually agreed upon risk management considerations, current and future site and water way use, the presence of structures, riverbank and beach type, river bottom slope, erosion and deposition potential, and the presence or absence of debris. For each SMA, site characteristics that are likely to factor in to the evaluation of remedial action alternatives should be identified in order to assemble retained process options into a range of remedial action alternatives applicable to each SMA.
5	Identify and screen Technology Process Options	The CERCLA RI/FS guidance calls for retained technology process options to be evaluated on the basis of effectiveness, implementability and cost. However, to streamline the Portland Harbor FS, retained technology process options should be assembled into a range of remedial action alternatives applicable to each SMA and screened on the basis

Step No.	Action	Description
		of effectiveness, implementability and cost.
6	Assemble and Remedial Action Alternatives	<p>Alternatives are assembled for each SMA based on consideration of SMA specific factors. A range of alternatives should be established that meet the RAOs established for the Portland Harbor Site. A range of remedial action levels for each SMA should be established that allow the RAOs to be achieved over a range of time-frames (0 years, 10 years and 30 years). The NCP and guidance requires consideration of both No Action alternatives (a requirement of CERCLA) all the way to alternatives that include treatment of principle threat material. Alternatives will feature the primary process options and include ancillary technologies such as dewatering, wastewater treatment, water quality management, transportation, and monitoring (long and short term). For example, a remedial action alternative centered on containment through capping will also require ancillary water quality controls, institutional controls and long-term monitoring. The set of remedial action alternatives should be surveyed to determine if the alternatives that have been identified represent a balanced range of alternatives for each SMA.</p>
7	Screen Remedial Action Alternatives	<p>Assembled remedial action alternatives should be screened based on a balanced evaluation of effectiveness, implementability, and cost. Implementability considerations for the process option are broader than for the technology types, and can consider issues such as the state of the technology and resource availability. Typically some technical development is required to refine alternatives so the implementation requirements and issues, including the requirement for source control prior to sediment action, are more clearly understood; the effectiveness, as defined by various performance metrics, is defined; and the costs are reasonably estimated. Alternatives should be developed in a manner, as much as possible, to meet risk management and ARARs compliance thresholds so the alternatives meet the basic threshold requirements of the Analysis of Alternatives done in the FS. Overall, the purpose of the screening is to reduce the list of alternatives for final analysis to a reasonable list. Typically the evaluation should consider whether the additional effectiveness of a given alternative of increasing rigor is worth additional cost and/or implementability challenges. Alternatives that do not meet protectiveness criteria can be eliminated from further consideration.</p>

Step No.	Action	Description
9	Evaluate Site-wide Technical Issues	Once a list of site-wide alternatives is developed, site-wide implementation requirements, such as total dredged volume or capping area and material volume, can be estimated. Site-wide impacts such as flood stage elevation impacts can be evaluated, along with various performance metrics.
10	Perform Additional Alternatives Screening and Refinement (if Needed)	With the full site-wide impacts identified, some additional refinement and screening of alternatives may be appropriate. For example, general disposal options may have limits on material that can be received, that may affect the ability to fully implement a specific removal alternative. These overall site constraints may create a need to modify an alternative or create new, hybrid options.
11	Perform Alternative Analysis – Threshold	<p>The analysis is done first by determining that the each alternative meets the threshold requirements of being protective and compliant with ARARs. If an alternative is not and cannot be made protective it can be eliminated from subsequent analysis.</p> <p>If an alternative is protective but cannot meet ARARs, either the alternative won't be selected, or it should be analyzed whether one of the basis for waiving the ARAR exists. The alternative would not necessarily be removed from subsequent balancing criteria analysis; it should be further analyzed if the benefits of the alternative may warrant a waiver.</p>
12	Perform Alternative Analysis – Balancing Criteria	Those alternatives that pass the threshold conditions (or pass protectiveness criteria with an ARARs waiver) should then be analyzed based on the balancing criteria of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume; short-term effectiveness; implementability; and cost. Given the number of alternatives being evaluated and the number of balancing criteria factors, it may be desirable to create a scoring matrix to assist in assessing performance against the balancing criteria.
13	Perform Alternative Analysis – Modifying Criteria	Modifying criteria – state and community acceptance – are typically gauged following completion of the draft FS. Preliminary issues will be identified by ODEQ as part of their support agency role. However, unless comprehensive outreach programs are implemented during the FS to obtain that information, it is inappropriate to conjecture the remedy preferred by the state or community just from FS analysis without public comment on the proposed plan.

Table 2 – Example Screening of Remedial Technologies and Process Options

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
No Action	None	Not Applicable	No Action	Required for consideration by NCP
Institutional Controls	Access Restrictions	Regulated Navigation Area	Provides notice to navigation to prevent damage to caps	Retained as ancillary technology
	Use Restrictions	Fish Advisories	Provides information on acceptable fish consumption rates and fish preparation techniques	Retained.
Natural Attenuation	Monitored Natural Recovery	Monitored Natural Recovery	Monitored Natural Recovery through physical (e.g., burial), chemical (e.g., photolysis) and biological (e.g., biological degradation) processes.	Retained
		Enhanced Monitored Natural Recovery/Thin Layer Placement	Enhancement of MNR (e.g., burial) through placement of a thin layer of material (e.g., 6" of sand).	Retained
Containment in Place	Capping	Sand Cap	Physical isolation of contaminants with sand cover.	Retained
		Sand Cap with Armoring	Physical isolation of contaminants with sand cover; armoring to prevent cap erosion.	Retained
		Sand Cap with Active Layer	Physical isolation of contaminants with sand cover; active layer to prevent contaminant migration.	Retained
		Sand Cap with Habitat Layer	Physical isolation of contaminants with sand cover; habitat layer to enhance reestablishment of benthic community	Retained
In-Situ Treatment	Biological/Chemical	Enhanced Bioremediation	Addition of nutrients and other amendments to enhance bioremediation	Tentatively Screened Out due to limited effectiveness
		Phytoremediation	Use of plants to remediate contaminated sediments	Tentatively Screened Out due to limited effectiveness
		Chemical Oxidation	Application of chemical oxidants to remediate contaminated sediments	Tentatively Screened Out due to limited effectiveness and high costs
	Contaminant Sequestration	In-Situ Solidification/Stabilization	The addition of reagents that immobilize and/or bind contaminants to the sediment in a solid matrix or chemically stable form.	PO is tentatively screened out due to limited technology demonstration and effectiveness in treating site COCs
		In-Situ Vitrification	Use of strong electrical current to heat sediment to temperatures above 2400°F to fuse it into a glassy solid.	PO is tentatively screened out due to limited demonstrated effectiveness in treating sediments and associated high costs
		Electrochemical Remediation	Innovative technology for destroying organic contaminants in situ by applying an alternating current across electrodes placed in the Subsurface to create redox reactions that destroy contaminants.	PO is tentatively screened out due to limited technology demonstration and effectiveness in treating site COCs

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
		In-Situ Carbon Absorption	Addition of activated carbon or other carbon materials to limit contaminant mobility and bioavailability	Retained
		Enhanced Cap Materials	Placement of active capping layers such as activated carbon or organoclay to prevent contaminant migration through capping materials	Retained
Removal	Dredging	Mechanical Dredging	Use of clamshell or environmental bucket to remove contaminated sediment. May be barge mounted or in the dry through application of coffer dams and dewatering	Retained
		Hydraulic Dredging	Use of hydraulic dredge to remove contaminated sediments. Requires extensive dewatering	Retained
		Diver Assisted Dredging	Diver assisted hydraulic dredging.	Retained
Ex-Situ Treatment	Pre-Treatment	In-barge Dewatering	Dewatering through passive dewatering on barge	Retained
		Lagoon Dewatering	Dewatering through placement in lagoon. Water discharge takes place on particles have settled out.	Retained
		Geotextile Tube Dewatering	Geotextile tubes allow water to migrate through membrane retaining sediments	Retained
		Mechanical Dewatering	Use of filter presses or other similar equipment	Retained
		Reagent Dewatering	Use of reagents to chemically absorb excess water.	Retained
	Biological Methods	Land Treatment	Large scale land treatment to reduce contaminant concentrations through biological processes.	Retained
		Composting	Large scale land treatment to reduce contaminant concentrations through composting.	Retained
		Biopiles	Large scale land treatment to reduce contaminant concentrations through biopiles	Tentatively Screened out due based on technical implementability.
		Slurry-phase Treatment	Biological treatment in a slurry phase.	Tentatively Screened out due based on technical implementability.
	Physical/Chemical	Particle Separation	Separation of sandier sediments with less contamination for beneficial reuse.	Retained
		Blending	Blending of contaminated sediment with other material for beneficial reuse.	Retained
		Cement Solidification/Stabilization	Solidification/stabilization of contaminated sediments through addition of Portland cement.	Retained

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
		Sorbent Clay Solidification/Stabilization	Solidification/stabilization of contaminated sediments through addition of sorbent clays such as bentonite.	Tentatively Screened out due based on technical implementability.
		Asphalt Emulsion	Treatment of contaminated sediments with asphalt emulsion to remove water and bind contaminants.	Tentatively Screened out due based on technical implementability.
		Sediment Washing	Wash sediments with water to remove contaminants.	Retained
		Chemical Extraction	Use chemical extractant to remove contaminants from sediment.	Tentatively Screened out due based on technical implementability.
		Chemical Oxidation/Reduction	Degradation of contaminants through redox or slurry oxidation.	Tentatively Screened out due based on technical implementability.
		Dehalogenation	Removal of halogens (e.g., chlorine) through chemical dehalogenation reactions.	Tentatively Screened out due based on technical implementability.
	Thermal Methods	Incineration	Thermal treatment through incineration.	Tentatively Screened out due based on technical implementability.
		Pyrolysis	Thermal treatment through pyrolysis.	Tentatively Screened out due based on technical implementability.
		Thermal Desorption	Heating of contaminated sediment to drive off and capture contaminants.	Tentatively Screened out due based on technical implementability.
		Vitrification	Application of electrical current to heat contaminated sediments to high temperatures.	Tentatively Screened out due based on technical implementability.

Note: The above table is for illustration purposes only and does not represent EPA's official view of whether a given technology should be retained or screened out.

Table 3 – Screening of Remedial Action Alternatives

General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	<p>In order to streamline the Portland Harbor FS, retained technology process options identified in the column to the left should be assembled into a range of remedial action alternatives for each SMA and screened on the basis of effectiveness, implementability and cost according to the following steps:</p> <ol style="list-style-type: none"> 1. Develop Sediment management areas (SMAs) based on an evaluation of site characteristics relevant to the screening, development and detailed evaluation of remedial action alternatives. 2. Assemble retained technology process options into a range of remedial action alternatives applicable to each SMA based on consideration of SMA specific factors. 3. Site specific factors include: site characteristics, such as contaminant sources, distribution and migration and exposure pathways; current and future site and water way use; and site characteristics such as presence of structures, riverbank and beach type, river bottom slope, erosion and deposition potential, and the presence or absence of debris. 4. A range of alternatives should be established that meet the RAOs established for the Portland Harbor Site. 5. Screen assembled remedial action alternatives s based on a balanced evaluation of effectiveness, implementability, and cost. 6. Use the results of the screening is to reduce the list of alternatives for the detailed evaluation of remedial action alternatives to a reasonable number. 		
Institutional Controls	Access Restrictions	Regulated Navigation Area			
	Use Restrictions	Fish Advisories			
Natural Attenuation	Monitored Natural Recovery	Monitored Natural Recovery			
		Enhanced Monitored Natural Recovery/Thin Layer Placement			
Containment in Place	Capping	Sand Cap			
		Sand Cap with Armoring			
		Sand Cap with Active Layer			
		Sand Cap with Habitat Layer			
In-Situ Treatment	Contaminant Sequestration	In-Situ Carbon Absorption			
		Enhanced Cap Materials			
Removal	Dredging	Mechanical Dredging			
		Hydraulic Dredging			
		Diver Assisted Dredging			
Ex-Situ Treatment	Pre-Treatment	In-barge Dewatering			
		Lagoon Dewatering			
		Geotextile Tube Dewatering			
		Mechanical Dewatering			
		Reagent Dewatering			
	Biological Methods	Land Treatment			
		Composting			
	Physical/Chemical	Particle Separation			
		Blending			
		Cement Solidification/Stabilization			
		Sediment Washing			
	Thermal Methods	Vitrification			

Attachment 1 – Proposed Risk Management Principles for Portland Harbor Feasibility Study

The following principles outline an approach for evaluating remedial action alternatives at the Portland Harbor Site. Site specific factors should be considered during application of the below principles.

1. Hot Spots of Contamination (Per DEQ Requirements) and Principle Threat Material should be dredged to the extent feasible and managed as appropriate. Material should be evaluated as to the suitability for in-water disposal (i.e., CDF or CAD) and upland disposal with or without treatment. Sediment that will be designated as listed or characteristic hazardous waste under federal or state law for disposal purposes, if any, should be identified to the extent possible for costing appropriate treatment and disposal. Hot spot thresholds should be based on high concentration, highly mobile and/or not reliably containable. Hot spot/Principle Threat Material removal should generally be sequenced to occur first before final remedies in the subject SMA and downstream SMAs are conducted.
2. In areas where the volume or depth of contamination is such that complete removal of hot spot or principle threat material is not feasible due to cost, implementability or other technological considerations, material left in place must be contained to ensure protectiveness. Caps, and associated institutional controls, must be designed to ensure that water quality is achieved and recontamination does not occur via contaminant migration through the cap. Performance standards for caps will consider risk-based and ARARs-based water quality criteria. Risk-based and ARARs-based criteria should be applied consistent with the exposure assumptions in the baseline human health and ecological risk assessments. Water based criteria will be applied to the upper 10 cm of transition zone water.
3. Lower Level Sediment Contamination that does not meet the Hot Spot of Contamination or Principle Threat Material threshold should be evaluated to determine whether capping will reduce risk more assuredly and effectively or monitored natural recovery will achieve protective risk based criteria or background levels within a reasonable time frame. MNR should be evaluated over a 10 and 30 year time frame.
4. If monitored natural recovery does not achieve protective risk based criteria or background levels within a reasonable time frame, more active remediation approaches will need to be used for lower level contamination, such as capping, thin layer placement, enhanced natural recovery and other techniques. MNR contingencies such as thin layer placement, capping and/or dredging should be included if the expected level of reduction is not achieved in 5 to 10 years.
5. Current and future land and river use and other site characteristics must be considered in determining the feasibility of dredging and capping. Key factors include land use, navigation requirements, the presence of structures such as docks and piers, in-water obstructions, debris, erosion and scour potential river bottom slope and beach and bank type. To the extent practicable, future site redevelopment should be a component of designing long-term, protective remedies. Remedial alternatives should attempt to accommodate existing infrastructure if necessary cleanup can be achieved, however the FS will need to evaluate the need to remove existing infrastructure as necessary to remediate hot spot and/or principle threat material. Likewise, the FS should analyze

alternatives that will accommodate/facilitate planned infrastructure to support future site redevelopment.

6. A floodway analysis should be performed on a site-wide basis to identify any constraints on the placement of caps or other work, such as potential mitigation and habitat restoration projects.
7. Short term impacts during remediation must be minimized to the extent practicable. Analysis of sediment suspension containment technologies for hot spot/Principle Threat Material versus lower level contamination needs to be conducted.
8. To the extent practicable, habitat mitigation and restoration should be a component of all remediation efforts and in particular in areas with existing or potential habitat value.
9. Institutional controls along with long-term maintenance will be employed to protect the remedy. The availability, implementability, and reliability of various institutional controls as a component of the overall remedy to achieve protectiveness (e.g., preventing cap damage) will need to be analyzed.

Attachment 2 – Application of Water Quality Standards and MCLs in the Portland Harbor FS:

A summary of the potential application of chemical specific ARARs (MCLs, aquatic life AWQC, human health fish consumption AWQC) as they relate to evaluation of sediment caps and water quality controls in the Portland Harbor FS is provided below. It should be noted that these requirements may change in the future and that NMFS and/or the State of Oregon may require additional requirements.

Capping Actions:

Water quality standards and MCLs pertaining to the Lower Willamette River shall be used in the evaluation of capping remedies at the Portland Harbor Site.

Chronic AWQC and Human Health fish consumption AWQC shall apply at the bottom of the biologically active zone. The biologically active zone is assumed to be 0 – 10 cm below mudline.

For human health criteria, spatial averaging is allowed. Spatial averaging should be based on the area of the cap or the exposure assumptions used baseline human health risk assessment, whichever is less. For aquatic life criteria, criteria must be met on a point by point basis.

Safe Drinking Water Act MCLs shall apply at the point of groundwater discharges and throughout the plume. For the portion of a groundwater plume that remains outside of an effective upland source control, MCLs shall apply downgradient of the source control measure. Safe Drinking Water Act MCLs shall only apply in areas where contaminated groundwater plumes enter the Willamette River.

For the purposes of capping evaluation, MCLs must be met through the plume (including the cap) unless it is determined that MCLs cannot be met due to material left in place based on a determination that it is not technically practicable to meet MCLs in a reasonable time frame.

In-Water Actions:

Water quality standards pertaining to the Lower Willamette River, except those human health criteria that may be impracticable, shall apply to all in-water dredging activities.

For purposes of evaluation of FS alternatives, it should be assumed that compliance points will be established at a distance of 100 meters (328 feet) from the point of the physical activity (e.g., dredging, cap placement) or 150 feet from the any outer containment structure.

The compliance distances are not an authorization to exceed those criteria concentrations for the entire duration of construction, but to allow the project to be implemented while using appropriate measures (BMPs) to reduce any potential exceedances of water quality criteria and/or negative impacts to beneficial uses.

Long-term degradation of water quality that significantly interferes with or becomes injurious to characteristic water uses, causes long-term harm, or impair beneficial uses shall not be allowed.

For in-water capping, dredging or other physical activity expected to result in the release of hazardous substances to the water column, containment barriers, silt curtains or other controls will be deployed to control such releases. Where containment barriers are used, the locations for compliance and monitoring will be 150 feet upstream and downstream of the edge of the barrier.

Water quality monitoring will be conducted for both conventional parameters (e.g., turbidity, temperature, dissolved oxygen, and pH) and toxic parameters (e.g., PAHs, PCBs, pesticides and metals).

Sampling depths for both the field and laboratory parameters will be located at the approximate top, middle, and bottom of the water column if the water depth permits collecting samples from three intervals separated by at least 5 feet from each other. Top and bottom samples will be taken 1 foot below the surface of the water and above the mud line, respectively. Thus, for water depths less than 7 feet, two samples will be collected and for water depths less than 2 feet, one sample will be collected.

Field parameters will be measured at the start of each operation at least once every hour during active in-water work. Laboratory parameters will be measured once a day for three consecutive days at the start of the project. These parameters will be measured once per week thereafter. Initial background conditions for the Site may be established prior to the start of any active in-water work.

In the event the water quality monitoring detects a water quality exceedance at any in situ compliance monitoring station for conventional pollutants, the situation will be assessed and a determination made as how to resolve the water quality problem.

In the event water quality monitoring detects a chemistry water quality exceedance of chronic criteria at any compliance monitoring station, BMPs must be reassessed to address the exceedance(s). All BMPs employed in response to an exceedance of the water quality criteria must be recorded and an effectiveness determination must be made after the results from the subsequent monitoring are received.

In the event water quality monitoring detects a chemistry water quality exceedance of acute criteria at any compliance monitoring station, work will immediately be stopped. Further evaluation will be performed to determine under what conditions operations may resume.

River velocity measurements will be conducted concurrently with the water quality monitoring activities to determine the need for ceasing operations at the removal area due to potential loss of silt curtain effectiveness.

Attachment 3 – EPA Guidance on Identification of Hot Spots of Contamination and Principal Threat Material

Contaminated material that is considered Principal Threat Material under federal law or a Hot Spot of Contamination under state law warrants special consideration in the Portland Harbor Feasibility Study.

Principle Threat Material: Under CERCLA, EPA expects to use treatment to address the principal threats posed by a site whenever practicable. EPA principal threat guidance identifies principal threat material as liquids (i.e., NAPLs), mobile source material and highly toxic source material. As stated in EPA's contaminated sediment guidance, contaminated sediment may be considered a principal threat where toxicity and mobility combine to pose a potential human health risk of 10^{-3} or greater for carcinogens.

Hot Spots of Contamination: Under the State of Oregon's Environmental Cleanup Law, hot spots of contamination are defined for media other than water as contamination that is high concentration, highly mobile or not reliably containable. High concentration is defined as exceeding a 10^{-4} risk level. Under state law, treatment and off-site disposal of hot spots of contamination must be evaluated in the FS with the application of a higher cost threshold.

At the Portland Harbor site, EPA believes that the principle threat material and hot spots of contamination should be identified for evaluation in the Portland Harbor FS. EPA understands that the practicability of the treatment of contaminated sediments that is considered principle threat material should be evaluated against the NCP's remedy selection criteria and EPA's sediment remediation guidance recognizes that treatment is generally not considered practicable at most sediment sites. EPA also recognizes that virtually all the sediments at the site exceed a 10^{-4} risk level. That said, EPA believes that principle threat material and hot spots of contamination should be identified for evaluation in the Portland Harbor FS based on high concentration, the presence of free product or NAPL, and whether the contamination can be reliably capped.

High Concentration:

Contaminated sediment that exceeds 10^{-4} risk level or 10 times the acceptable risk level for non-carcinogens or 10 times the acceptable level for ecological receptors is considered a hot spot of contamination under State of Oregon cleanup requirements. As a result, removal and treatment or removal and off-site disposal of contaminated sediment exceeding hot spot thresholds should be evaluated through the application of a higher cost threshold. EPA acknowledges that even with the application of a higher cost threshold, removal of all contaminated sediment above hot spot thresholds may not be practicable.

In addition, contaminated sediment exceeding a 10^{-3} risk level should also be identified and evaluated in the FS for removal and treatment or/ or in-situ treatment. As stated above, EPA acknowledges that treatment may not be considered practicable based on application of the NCP remedy selection criteria.

High concentration thresholds should be based on actual concentrations relative to multipliers of the PRGs rather than risk based hill top values.

Not Reliably Containable:

The reliably containable determination is expected to be the most relevant for the Portland Harbor site. Contaminated sediments that can not be capped in a protective manner because of upward contaminant migration through the cap will have a preference for in-situ treatment, removal and treatment and/or removal and off-site disposal. Cap models should be applied to estimate contaminant concentrations that can not be reliably capped considering a range of site specific conditions including groundwater flux rates.

Highly Mobile:

Under both state and federal law and guidance, highly mobile contamination is generally considered to be contaminated liquids. As a result all areas of sediment contamination where product is present should be considered hot spot and principal threat material.

Attachment 4 – Long Term Monitoring Cost Considerations

This document provides a general framework for establishing components of a long-term monitoring plan. Monitoring during implementation and monitoring following construction to verify cleanup levels and that design specifications were achieved is not addressed here. These recommendations are intended for costing purposes and are not intended to be binding as to the description and extent of the long-term monitoring plan.

The long-term monitoring plan should be guided by a few general principles:

- 1) Sampling should be conducted in a consistent fashion over time to allow comparisons between data sets. As similar of locations, seasons, and samples should be collected over time to permit evaluation of remedial effectiveness.
- 2) Sampling design (sample numbers, locations, density, and frequency) needs to be conducted in a manner that permits a statistically valid comparison of differences between pre- and post-remediation timeframes and establishing whether cleanup targets have been achieved. Defining the spatial aggregation and data analysis methods during this step is fundamental to a successful monitoring plan design. For these processes, a Data Quality Objectives (DQO) process should address monitoring objectives (which questions will be addressed), monitoring design (which parameters will be assessed) and decisions rules (what constitutes a remedy success or failure and contingency actions).
- 3) Future monitoring results should be compared to those from a baseline monitoring period. A comparison of pre- and post-remediation trends is the most effective means to ascertain differences in conditions during those timeframes, so multiple years of baseline (more than two) are required. If RI data are not sufficient to support the analyses, baseline monitoring should be initiated during the FS and design phase.
- 4) The initial rounds of the long-term monitoring plan should occur annually. As monitoring progresses, the frequency of monitoring may be reduced to 5 year intervals. Monitoring should continue indefinitely or until such time as the remedial action objectives have been achieved (e.g., fish tissue levels have been reduced to protective concentrations).

Broad, Harbor Wide Monitoring:

This monitoring effort is a site wide monitoring program that will be used to evaluate the remedy as a whole in terms of its ability to achieve remedial action objectives (e.g., reduce tissue concentrations to acceptable levels). A reference station (e.g., unremediated upstream area) should also be monitored to provide context to trends in remediated areas. The following components should be included:

- Biota Tissue: Representative species should include adult carp, adult smallmouth bass, young-of-the year smallmouth bass, and clams to encompass organisms from different

trophic guilds and age classes that are relevant to human exposure and closely linked to site conditions (e.g., not migratory). Sampling should occur during the summer period when contaminant concentrations are anticipated to be greatest.

- Surface Water: Surface water monitoring should occur during the period when concentrations are anticipated to be greatest based on historical analyses (e.g. summer low flow periods). The control site and five transects (RM 2, RM 4, Multnomah Channel, RM 7 and RM 11) should be targeted.
- Sediment: Because cleanup options are directed towards contaminated sediment, long term monitoring of sediments will be required. To the extent cleanup decisions are based on an acceptable level of sediment toxicity, sediment bioassays should also be considered.

Remedy Performance Monitoring:

This monitoring effort is intended to evaluate whether the specified remedial actions within an area have achieved their intended purpose in the anticipated time frame.

MNR

Monitoring should be conducted to verify that putative MNR mechanisms (e.g. burial) are occurring through time and that expected trends in sediment concentrations are being achieved. The spatial areas of interest will correspond with the AOPC or SMA area designated for MNR. If goals are not met, contingency actions will be required per an adaptive management framework (e.g. if monitoring does not indicate anticipated reductions following the first 5 years of monitoring, then more aggressive cleanup actions will take place). If MNR is selected to address areas of benthic risk, bioassays should be conducted in concert with chemical and physical evaluations. To the extent sediment deposition is a component of monitored natural recovery, sediment trap and sediment stake deployment should also be incorporated into the harbor-wide monitoring program.

Capping

Caps need to be monitored to ensure they are performing as intended. For instance, isolation caps should maintain separation between contaminated sediments and organisms residing within the bioactive zone. “Active caps” should eliminate upward migration of contaminants through the cap. These processes should be monitored over time to ensure they are still functioning.

Isolation caps. Over time, the ability of caps to isolate contaminated materials can be impacted by physical forces such as erosion, deposition, or consolidation. Annual bathymetry of the caps will provide a general view of the cap and indications of variations in substrate height. However, bathymetry alone cannot discern between competing forces on cap structure such as deposition or consolidation, so coring studies in conjunction with a visually distinctive base layer should be used to establish cap effects on cap thickness. Settlement plates can also be used. Analysis of contaminants of concern should occur at least within the surface bioactive zone to indicate trends in contaminant concentrations. If samples exceed cleanup levels, chemical evaluations of cores should take place to investigate the origin of contaminants.

Active caps. In those areas where groundwater upwelling is a concern and caps contain an “active” component designed to eliminate vertical migration of contaminants, the vertical profile of porewater contaminants should be sampled to evaluate porewater contaminant concentrations in the bioactive zone and establish whether contaminant migration is occurring. Sampling of groundwater seeps to estimate contaminant flux should also be conducted to evaluate the impact on the remedial action.

Habitat caps. In those areas where a habitat layer is included, monitoring to benthic recolonization rates or some other measure of habitat health should be included.

Dredging

Following post-dredge confirmation monitoring to establish that cleanup levels have been met, long term monitoring of sediment contaminant concentrations should be conducted to evaluate whether cleanup levels have been maintained.

Timing and Number of Samples:

As mentioned above, the sampling temporal and spatial resolution should be established based on the process response characteristics and a statistical design that permits making valid conclusions about the significance of observed changes. For costing purposes the following approximations can be used.

- Bass and carp: 10 - 20 tissue samples per monitoring effort; clams and sculpin: 20 - 40 samples. Samples may need to be targeted towards specific locations.
- Surface water: five transects (RM 2, RM 4, Multnomah Channel, RM 7 and RM 11) and a reference station.
- For pore water sampling: Two to four samples per acre of cap material.
- Sediment monitoring: Three 5-point composites per SMA or per acre of cap or dredged area.

It should be noted that the numbers outlined above are for costing purposes only and may change in the future. As stated in the general principles above, the monitoring program should be developed according to a DQO process that takes into account the objectives and design of the remedial action program.